Human Anatomy

Lec.18 **Dr Ban Alwash**

The Larynx

The larynx provides a protective sphincter at the inlet of the **air passages** and is responsible for **voice production**. It is situated below the **tongue** and **hyoid bone** and between the great blood vessels of the neck and lies at the level of the **fourth, fifth, and sixth cervical vertebrae (Fig.1)**. It opens above into the **laryngopharynx**, and below, it is continuous with the **trachea**. The larynx is covered in front by the **infrahyoid strap muscles** and at the sides by the **thyroid gland**. The framework of the larynx is formed of **cartilages** that are held together by **ligaments** and **membranes**, moved by **muscles**, and lined by **mucous membrane**.

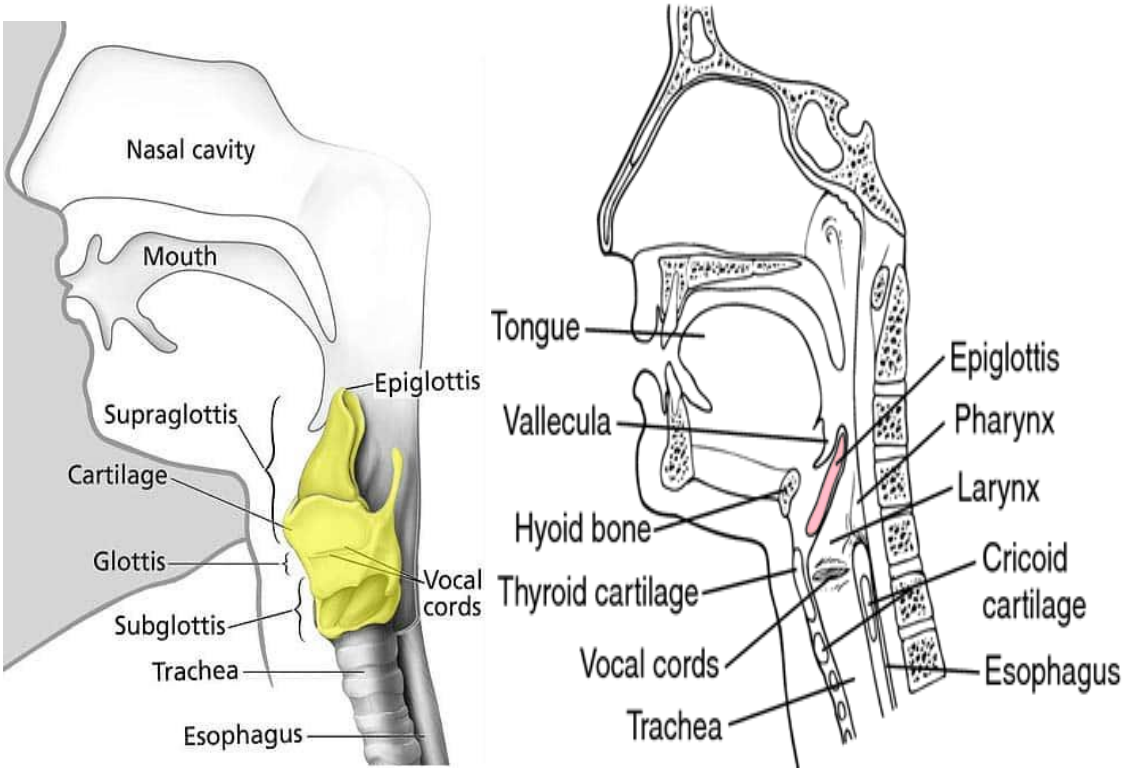


Figure 1: The larynx situation

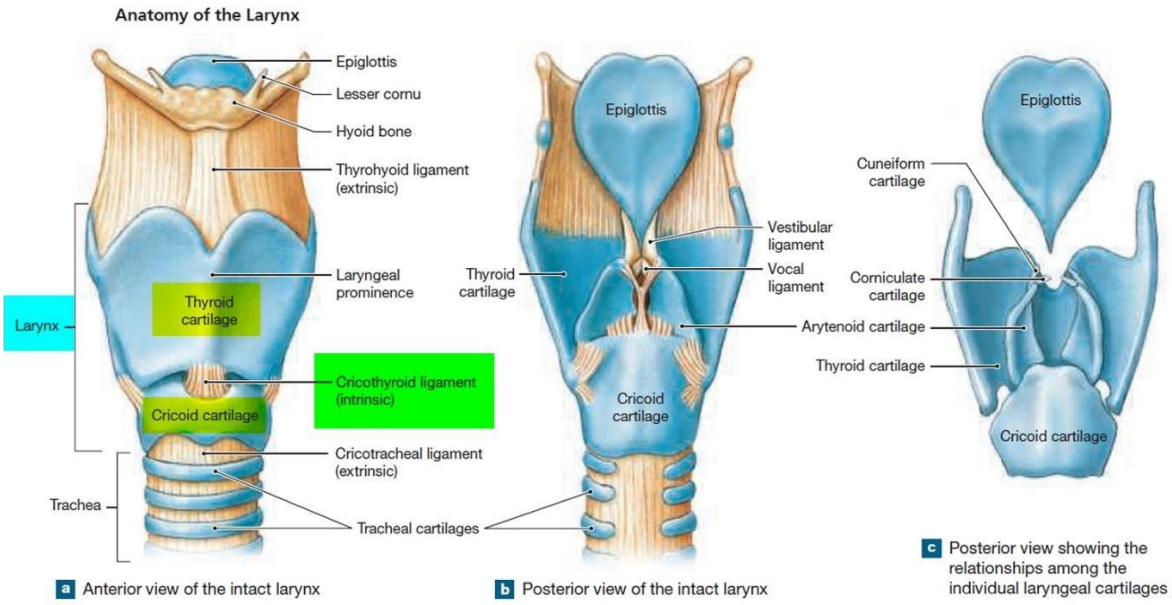


Figure 2: A-Anterior view of the larynx and its ligaments from the front. B- Posterior view of the larynx. C. Posterior view of the larynx showing relashionships.

Laryngeal Cartilages

3 unpaired Cartilages and 3 paired cartilages make up the skeleton of the larynx (Fig. 2).

Unpaired Cartilages

- Epiglottis
- Thyroid cartilage
- Cricoid cartilage

Paired cartilages

- Arytenoid cartilages
- Corniculate cartilages
- Cuneiform cartilages

- **Epiglottic cartilage**: This leaf-shaped lamina of elastic cartilage lies behind the root of the tongue **(Fig. 2).** Its stalk is attached to the inner surface of the thyroid cartilage. The sides of the epiglottis are attached to the arytenoid cartilages by the **aryepiglottic folds** of mucous

membrane. The upper edge of the epiglottis is free. The covering of mucous membrane passes forward onto the posterior surface of the tongue as the **median glossoepiglottic fold**; the depression on each side of the fold is the **vallecula**. Laterally, the mucous membrane passes onto the wall of the pharynx as the **lateral glossoepiglottic fold (Fig. 2).**

- **Thyroid cartilage**: This is the largest cartilage of the larynx and consists of two **laminae** that meet in the midline in the deep-set thyroid notch (V angle). The distinct laryngeal prominence **(Adam's apple)** projects forward from the apex of the thyroid notch. The posterior border extends upward into a **superior cornu** and downward into an **inferior cornu.** An oblique line for the attachment of muscles is on the outer surface of each lamina (Fig1,3).
- **Cricoid cartilage:** This cartilage lies below the **thyroid cartilage** and is shaped like a signet ring, having a broad lamina behind and a shallow arch in front. It is the only completely circular element in the respiratory tract. The cricoid cartilage has an **articular facet** on each side of the lateral surface for articulation with the **inferior cornu** of the thyroid cartilage. Posteriorly, the lamina has an articular facet on its upper border on each side for articulation with the **arytenoid cartilage** (Fig1,3).

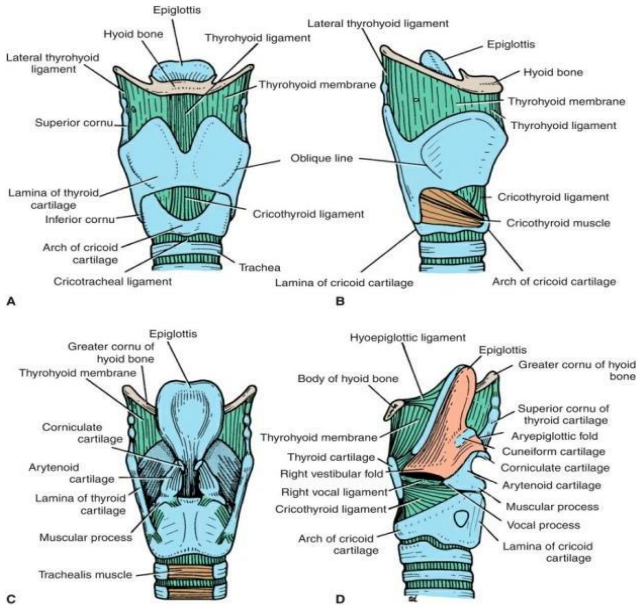


Figure 3: The larynx and its ligaments from the front (A), from the lateral aspect (B), and from behind (C). D. Lateral view with the left lamina of the thyroid cartilage removed to display the interior of the larynx.

➢ **Arytenoid cartilages:** Paired, small, **pyramid-shaped** arytenoid cartilages located at the back of the larynx articulate with the upper border of the lamina of the cricoid cartilage. Each cartilage has an **apex** above that articulates with the small **corniculate cartilage**, **a base** below that articulates with the lamina of the cricoid cartilage, and a vocal process that projects forward and gives attachment to the **vocal ligament**. A muscular process that projects laterally give attachment to the posterior and **lateral cricoarytenoid muscles**.

➢ **Corniculate cartilages:** Two small, **conical-shaped** corniculate cartilages articulate with the apices of the arytenoid cartilages. They give attachment to the **aryepiglottic folds (Fig 3).**

➢ **Cuneiform cartilages**: These two small **rod-shaped** cartilages are in the aryepiglottic folds and serve to strengthen them.

Membranes and Ligaments of the Larynx

1-Thyrohyoid membrane: This connects the upper margin of the **thyroid cartilage** to the **hyoid bone**. In the midline, it is thickened to form the median thyrohyoid ligament.

➢ **Cricotracheal ligament:** This connects the cricoid cartilage to the first ring of the trachea.

2-Quadrangular membrane: This extends between the **epiglottis** and the **arytenoid cartilages.** Its thickened inferior margin forms the vestibular ligament.

➢ **Cricothyroid ligament:** The lower margin is attached to the upper border of the cricoid cartilage. The superior margin of the ligament, instead of being attached to the thyroid cartilage, ascends on the medial surface of the **thyroid cartilage**. Its upper free margin, composed almost entirely of elastic tissue, forms the important vocal ligament on each side. The **vocal ligaments** form the interior of the vocal folds **(vocal cords)**. The anterior end of each vocal ligament is attached to the **thyroid cartilage**, and the posterior end is attached to the vocal process of the **arytenoid cartilage (Fig. 4).**

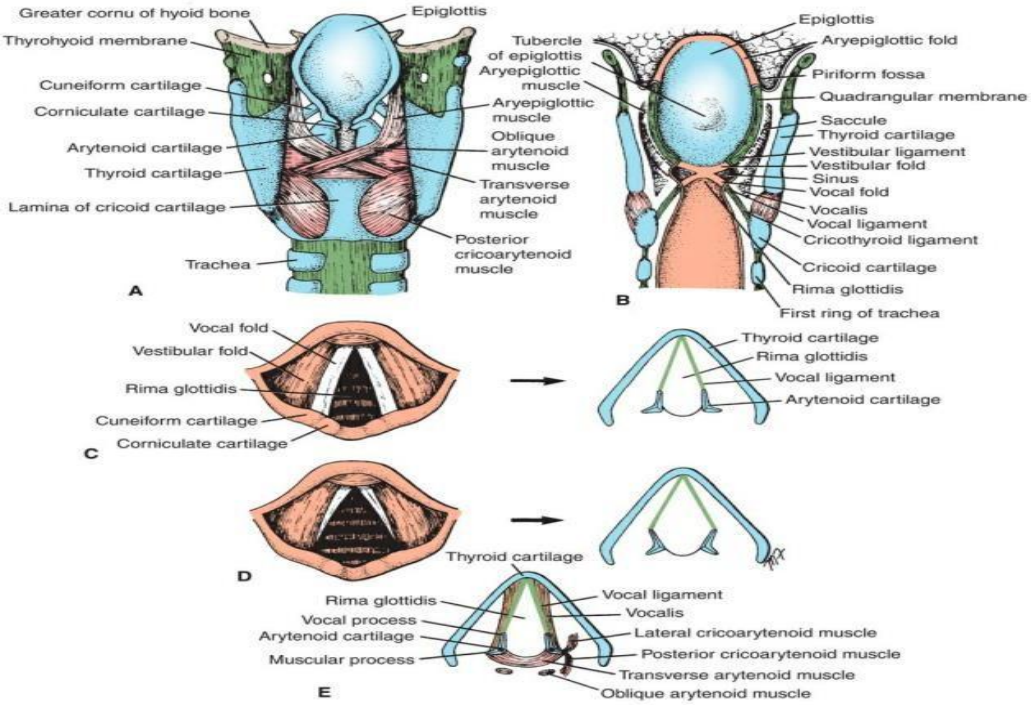


Figure 4: A. Muscles of the larynx seen from behind. B. Coronal section through the larynx. C. Rima glottidis partially open as in quiet breathing. D.Rima glottidis wide open as in deep breathing. E. Muscles that move the vocal ligaments.

Laryngeal Fold

- **Vestibular Fold (False Vocal Fold):** The vestibular fold is a **fixed** fold on each side of the larynx **(Figs. 4)**. It is formed by mucous membrane covering the vestibular ligament and is **vascular** and **pink in color.**

- **Vocal Fold (True Vocal Fold)** The vocal fold is a **mobile** fold on each side of the larynx and is concerned with voice production. It is formed by mucous membrane covering the vocal ligament and is **a vascular** and **white in color**. The vocal fold moves with respiration, and its **white color** is easily seen when viewed with a laryngoscope. The **rima glottidis** is the aperture between the vocal folds. The **glottis** is the rima plus the vocal folds. The glottis is the narrowest part of the larynx and measures about **2.5 cm** from front to back in the male adult and less in the female. In children, it is lower part of the larynx within the **cricoid cartilage (Fig. 4).**

Cavity of the Larynx

The cavity of the larynx divided into three regions:

1- vestibule, which is situated between the **inlet** and the **vestibular folds**

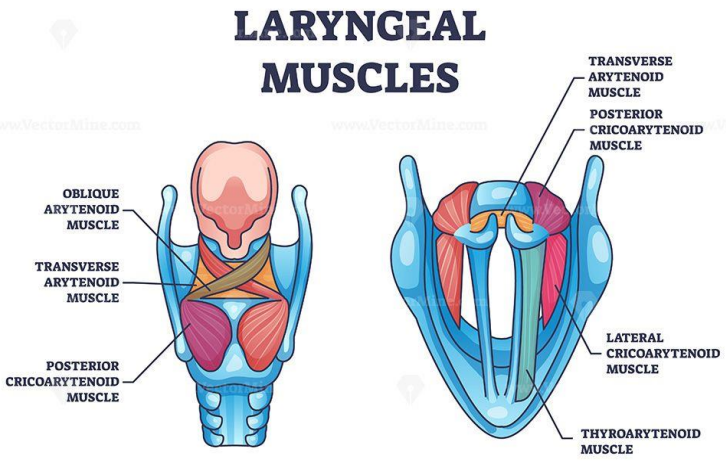
2- middle region, which is situated between the **vestibular folds** above and the **vocal folds** below

3- lower region, which is situated between the **vocal folds** above and the lower border of the **cricoid cartilage** below.

Laryngeal Muscles

The muscles of the larynx are arranged in two groups: **extrinsic** and **intrinsic.** The extrinsic muscles have attachments **outside the larynx itself**, whereas the intrinsic muscles have both origin and insertion onto **laryngeal elements**.

- **Extrinsic Muscles:** These muscles move the larynx up **(elevation) and down (depression)** during swallowing. There are many muscles attached to the **hyoid bone**, which is attached to the **thyroid cartilage** via the thyrohyoid membrane. Thus, movements of the larynx accompany movements of the hyoid bone. The suprahyoid muscles **elevate the larynx** and the infrahyoid muscles **depress the larynx**.
  - **Elevation:** The digastric, stylohyoid, mylohyoid, geniohyoid, stylopharyngeus, salpingopharyngeus, and palatopharyngeus muscles.
  - **Depression:** The sternothyroid, the sternohyoid, and the omohyoid muscles.



- **Intrinsic Muscles**: The intrinsic muscles of the larynx are summarized in **Table (1).**
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Table1: Larynx Intrinsic Muscles

MUSCLE	ORIGIN	INSERTION	NERVE SUPPLY	ACTION
Muscles Controlling the Laryngeal Inlet				
Oblique arytenoid	Muscular process of arytenoid cartilage	Apex of opposite arytenoid cartilage	Recurrent laryngeal nerve	Narrows the inlet by bringing the aryepiglottic folds together
Thyroepiglottic	Medial surface of thyroid cartilage	Lateral margin of epiglottis and aryepiglottic fold	Recurrent laryngeal nerve	Widens the inlet by pulling the aryepiglottic folds apart
Muscles Controlling Vocal Fold (Cord) Movement				
Cricothyroid	Side of cricoid cartilage	Lower border and inferior cornu of thyroid cartilage	External laryngeal nerve	Tenses vocal cords
Thyroarytenoid	Inner surface of thyroid cartilage	Arytenoid cartilage	Recurrent laryngeal nerve	Relaxes vocal ligament
Vocalis	Deep fibers of the thyroarytenoid		Recurrent laryngeal nerve	Local tension on vocal ligament
Lateral cricoarytenoid	Upper border of cricoid cartilage	Muscular process of arytenoid cartilage	Recurrent laryngeal nerve	Adducts the vocal cords by rotating arytenoid cartilage
Posterior cricoarytenoid	Back of cricoid cartilage	Muscular process of arytenoid cartilage	Recurrent laryngeal nerve	Abducts the vocal cords by rotating arytenoid cartilage
Transverse arytenoid	Back and medial surface of arytenoid cartilage	Back and medial surface of opposite arytenoid cartilage	Recurrent laryngeal nerve	Closes the posterior part of rima glottidis by approximating arytenoid cartilages

Two muscles modify the laryngeal inlet (Fig. 4):

- **Narrowing the inlet:** The oblique arytenoid muscle.
- **Widening the inlet:** The thyroepiglottis muscle.

Five muscles move the vocal folds (cords) (Fig. 5):

- **Tensing the vocal cords:** Cricothyroid and vocalis muscles.
- **Relaxing the vocal cords:** Thyroarytenoid muscle.
- **Adducting the vocal cords:** Lateral cricoarytenoid muscle.
- **Abducting the vocal cords:** Posterior cricoarytenoid muscle.
- **Approximates the arytenoid cartilages**: Transverse arytenoid muscle.

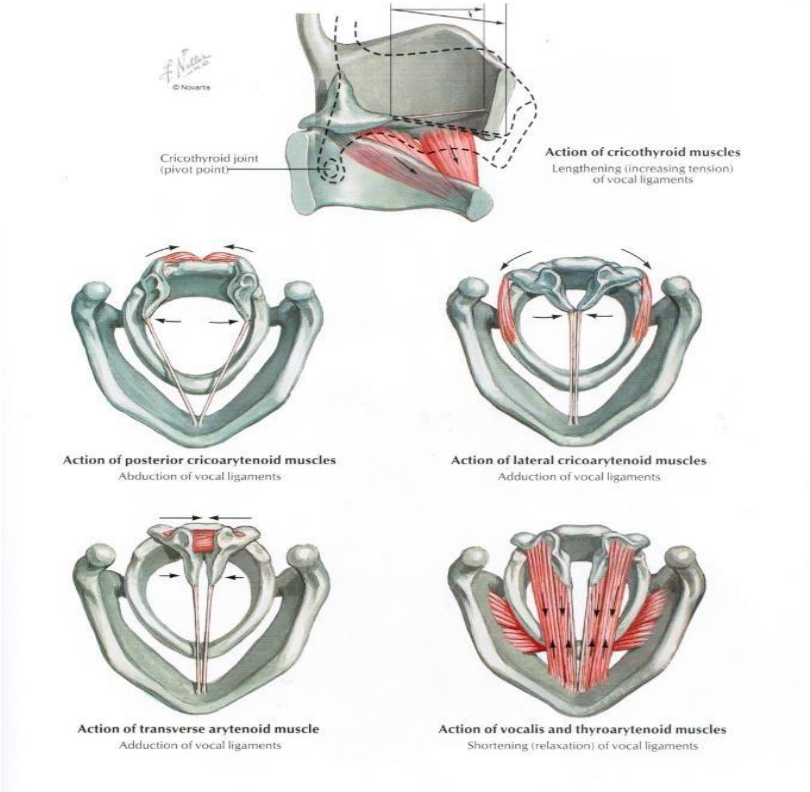

Figure 5: Action of Intrinsic Muscles of Larynx

Mucous Membrane of the Larynx

The mucous membrane of the larynx lines the cavity and is covered with **ciliated columnar epithelium.** On the vocal cords, however, where the mucous membrane is subject to repeated trauma during phonation, the mucous membrane is covered with **stratified squamous epithelium.**

Nerve Supply of the Larynx

The vagus nerve (CN X) supplies the entire larynx through its **superior** and **recurrent branches (Fig.5).**

The superior laryngeal nerve divides into **external** and **internal laryngeal nerves** above the larynx. The external laryngeal nerve descends on the exterior of the larynx and extends to the **cricothyroid muscle**.

The **internal laryngeal nerve** penetrates the lateral aspect of the thyrohyoid membrane (in company with the superior laryngeal artery) and enters the larynx.

The **recurrent laryngeal nerve** ascends the neck and becomes the **inferior laryngeal nerve** when it passes the inferior border of the cricoid cartilage and enters the larynx **(Fig 6).**

Sensory Nerves.

- **Above the vocal cords**: The **internal laryngeal branch** of the **superior laryngeal branch of the vagus.**
- **Below the level of the vocal cords**: **recurrent laryngeal nerve.**

Motor Nerves

- The **external laryngeal nerve** supplies the cricothyroid muscle.
- The **recurrent laryngeal nerve** supplies all the **intrinsic muscles** of the larynx except the **cricothyroid muscle.**

Laryngeal Blood Supply

- **Upper half of the larynx**: Superior laryngeal branch of the **superior thyroid artery.**
- **Lower half of the larynx**: Inferior laryngeal branch of the **inferior thyroid artery**

Laryngeal Lymph Drainage

The lymph vessels drain into the **deep cervical group of nodes**.

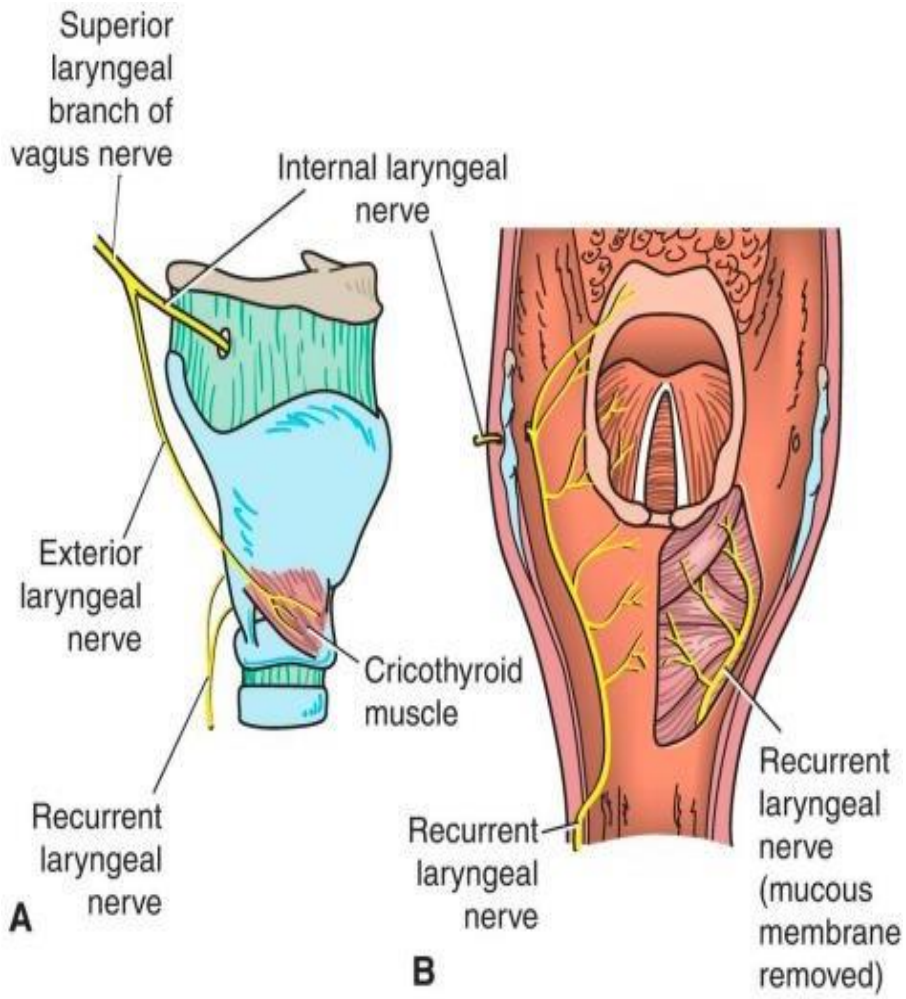

Figure 6: A. Lateral view of the larynx showing the internal and external laryngeal branches of the superior laryngeal branch of the vagus nerve. B. The distribution of the terminal branches of the internal and recurrent laryngeal nerves. The terminal branches of the recurrent laryngeal nerve are named the inferior laryngeal nerve. The larynx is viewed from above and posteriorly.

References

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